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IMPURITY SEGREGATION AND ITS EFFECTS ON THE OPTICAL PROPERTIES OF KH_2PO_4

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Numerous investigations have shown that trivalent cations such as Al and Fe are preferentially incorporated into {100} sectors of KH_2PO_4 (KDP) resulting in high UV absorption. Other research has indicated that impurities are differentially incorporated into adjacent sectors of growth hillocks on the {101} faces. We present the results of ICP, SIMS and UV spectroscopy, X-ray topography and index homogeneity measurements which identify and quantify the UV active species in both sectors of KDP crystals as well as their effects on optical properties. The distribution of Sb, Cr and heavy metals is strongly correlated with optical absorption at 200nm while Fe, Al and Zr levels correlate with absorption at 270nm. While the levels of all these contaminants are considerably higher in the {100} sector, Fe, Al and Zr levels are also strongly dependent on the growth rate along [100]. We also find that the impurity level in the shallowest sector of the growth hillocks on the {101} face is higher than that of the adjacent sectors. These variations are shown to lead to inhomogeneities in the refractive indices, generating phase distortions of transmitted light as well as low thresholds for laser damage at the sector boundaries. However, following thermal annealing at 150°C, the damage threshold of the boundaries becomes equal to that of the surrounding material suggesting that these impurity differences generate stresses at the interface which are relieved by thermal annealing. We present a model for impurity segregation in KDP based on the distribution and type of kink sites on the two faces. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-ENG-48.